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TECHNICAL EQUIPMENT REPORT NO. 5700-4
FEBRUARY 15, 1962

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CURRENT SERIAL RECORD

FOREST FIREFIGHTING EXTERNAL TANK FOR DeHAVILAND BEAVER DHC-2 SEAPLANE

BY
ELY SERVICE CENTER
FOREST SERVICE, U. S. DEPARTMENT OF AGRICULTURE
ELY, MINNESOTA



ISSUED BY
FOREST SERVICE
U. S. DEPARTMENT OF AGRICULTURE
WASHINGTON 25, D. C.



UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
WASHINGTON 25, D.C.

IN REPLY REFER TO

5700

February 28, 1962

The external water tank installation for DeHavilland Beaver DHC-2 Seaplane described in Technical Equipment Report No. 5700-4 are approved for optional U.S. Forest Service use. Specifications, including reduced drawings, are in the report. Full-size drawings may be obtained from the Regional Forester, North Central Region, Forest Service, 710 N. 6th Street, Milwaukee 3, Wisconsin.

When tank is filled or aircraft is used for water or retardant dropping, the aircraft is subject to the limitations of CAR Part 8 and no passengers will be carried.



MERLE S. LOWDEN, Director
Division of Fire Control



February 15, 1962

FOREST FIREFIGHTING EXTERNAL TANK FOR

DeHAVILLAND BEAVER DHC-2 SEAPLANE

INTRODUCTION

In 1956 a water pickup was attached to an outboard motorboat to see whether water could be forced through the tube while the boat was in motion. This was the first step of many in determining whether a seaplane taxiing over a lake surface on takeoff could pick up water for cascading on forest fires. The experiments proved the feasibility of the method and also that the pickup tube need not be movable.

In 1957, a 125-gallon tank was mounted inside the cabin of a Noorduyn-Norseman and water was dumped through it's 23-inch hatch aft in the cabin floor. The following year, the pickup and dropping equipment were modified to fit the DeHavilland-Beaver DHC-2 from which water was also dumped from the cabin through a 17-inch diameter floor hatch. Accounts of these experiments are given in Forest Fire Control Notes 1958 19(3): 123 and 1961 22(3): 93. While the results were promising, there were certain deficiencies that needed to be corrected; e.g., obstruction of the cabin with the tank and the inability to discharge water rapidly enough through the narrow floor hatch.

Considering this, the DeHavilland Aircraft of Canada Limited, Toronto, developed a design that used two small cylindrical tanks, one mounted on each float on fore and aft trunnions. Water was taken on by a scoop-type draft tube. The tanks were dumped by turning over, and a simple wind vane rotated the tanks back to an upright position. Although this design has the advantage of rapid water release, a divided splash pattern was made which was less effective than the single more highly concentrated pattern from a single tank. The presence of tanks prevent the use of the pontoon racks for cargo dropping, and the trunnions prevent adequate streamlining of the tanks. Thus, seaplane characteristics were affected in that there is a 12 m.p.h. loss of cruising speed.

The project reported here was undertaken to overcome the handicaps of previous designs by mounting a streamlined water tank under the fuselage and between the floats. The main problems were those of attaching the tank to the seaplane and constructing it so that the dump gates and water would clear the maze of struts and wire beneath. In general, these aims have been met. There is a notable decrease in air drag and cabin space and pontoons are available for other uses. Drop patterns are greatly improved, and the tank is easily mounted for almost instant use; it takes only a few minutes to install the pickup tube.



The external tank and equipment described in this report are for use on a DeHavilland Beaver DHC-2 Seaplane. By modification, they can be adapted for use on the DeHavilland Otter Seaplane.

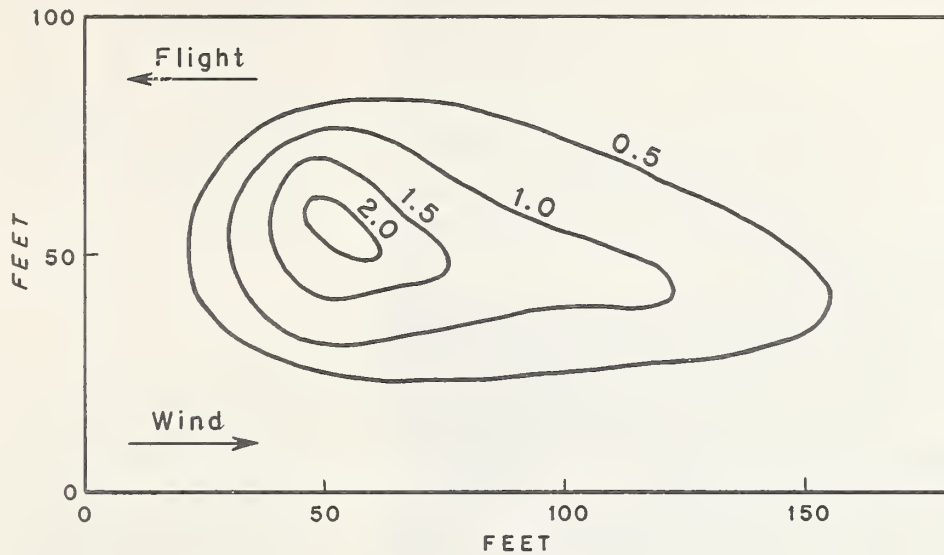
Data resulting from 14 drop tests with this equipment, and the average typical drop pattern, are of interest. The tests were made during the period July 12-14, 1961, at the Ely airport under the supervision of the Lake States Forest Experiment Station.

	<u>Average pattern</u> (feet)
Total length	211
Total <u>effective</u> length	157
(over 0.4 gal. water per 100 sq. ft.)	
Effective pattern width	61
(over 0.4 gal. water per 100 sq. ft.)	
<u>Concentrations per</u> <u>100 square feet</u> (gallons)	<u>Average total area</u> <u>covered</u> (square feet)
0.4-0.5	5,802
1.0	2,198
2.0	507
3.0	<u>1/</u> 418
Average maximum concentration at pattern center (gal./100 sq. feet) <u>2/</u>	3.3

1/ Average of 6 drops (out of 14) that had water in excess of 3 gallons per 100 square feet.

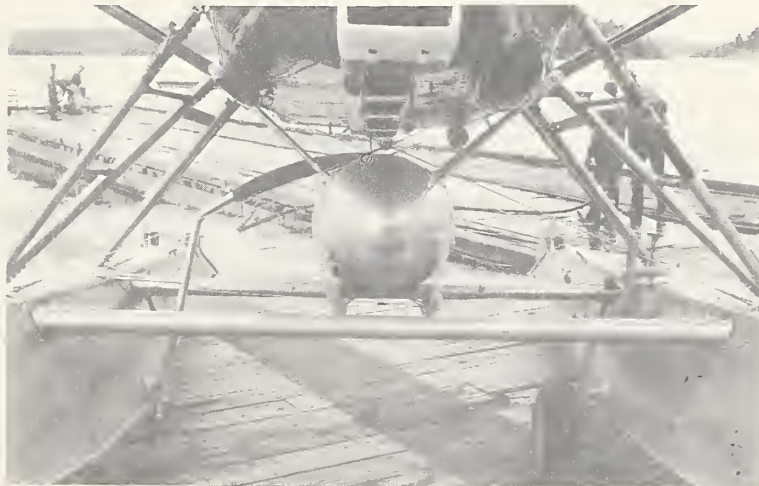
2/ Average maximum amount of water measured in any one can in the pattern.

AVERAGE TYPICAL DROP PATTERN



Air speed, 80 m.p.h.; drop height,
100 feet; contours in gallons per
100 square feet.

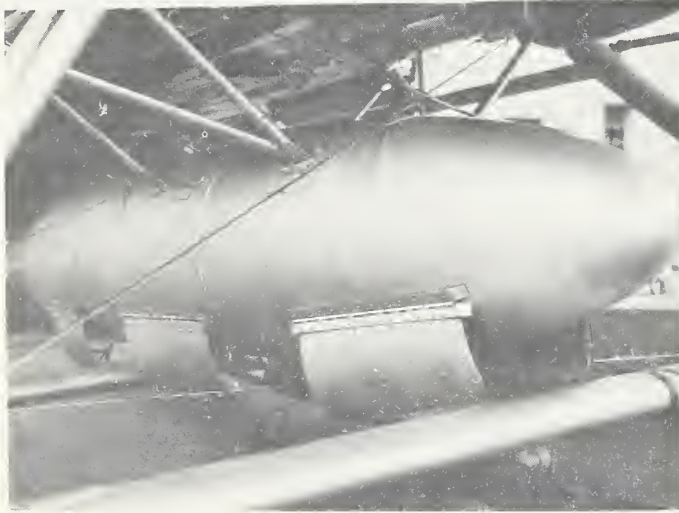
DETAILS OF 125-GALLON EXTERNAL WATER TANK



The tank is suspended from the seaplane in such a manner as to make mounting and dismounting a quick and simple operation. It was originally an F-87 jet wing fuel tank with a capacity of 230 U.S. gallons. Cut down to meet the weight limitations of the DeHavilland Beaver, it has a 125-gallon capacity.



Approximately 10 seconds are required to fill the tank when taxiing at about 40 m.p.h. Tank is filled by means of a water scoop; excess water is lost through an overflow hole at top of tank.



The 6 doors on the tank, shown here in an opened position, comprise an area of more than 700 sq. in.; they permit a fast, clean, free fall of water. They are closed while the tank is being filled, and then opened by pushing down on a control rod in the cockpit. To close again, the control rod is simply pulled up by the pilot, it is held in the closed position by the mechanism itself.

CONSTRUCTION PLANS FOR WATER TANK INSTALLATION

Material,--Standard aluminum sheet such as 5052 and 2024 alloys may be used for backing, filler, and reinforcing plates. Other structural members are as noted on drawings. Struts can be made of either 1-1/8 by 0.058, 1-1/8 by 0.065, or 1-1/4 by 0.049 streamline tubing. Water scoop is made of 1-1/2 by 3-1/2 oblong tubing. Description of tank... Tank, fuel, aircraft, external, removable. Capacity, 230 U.S. gallons. Spec. #Mil-T-7378(USAF). Manuf. No. ST 23-4800. Manufactured by Fletcher Aviation Co., Pasadena, Calif. All nuts and bolts are aircraft-quality, heat-treated alloy steel.

Door actuation mechanism,--Release and closure is obtained by a pulley arrangement in conjunction with a control rod to cockpit. This is strictly a mechanical arrangement, the doors being held closed by bringing pulley, through which cable to door is threaded, to just over center (see drawing in appendix) and held from going further by a stop.

Door hinges and seals.--Door hinges are regular piano hinges with cadmium or similar plating as a protection against rust. Seals are made from a sponge rubber weatherstrip 1/2 inch wide by 5/32nds inch thick, similar to Johns-Manville Rub-R-Shim No. 110.

Miscellaneous.--All radii given on plans should be considered minimum. It is suggested that balsawood and tape be used as blocking to streamline strut assembly where attached to plane fuselage. All steel members should be coated with at least one coat of rust-inhibiting paint.

Inspection.--FAA approval on the tank has been obtained. (See Form ACA-337 in the appendix.)

Drawings.--Authorized contractors and cooperators working with the Forest Service can obtain full-size working drawings from the Regional Forester, U.S. Forest Service, 710 N. Sixth Street, Milwaukee 3, Wisconsin. Drawings for external water tank for DHC-2 Beaver Aircraft, Sheets 1-3, are in the appendix to this report.

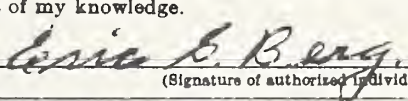

Alterations and modifications.--During the summer of 1961, the following alterations were tried and appear to have good possibilities. They have not been fully tested and are therefore not included in the plans: (1) Use of 3-inch circular tubing for intake tube. (2) Electric control for water release; this consists of 12-volt solenoid with button to supplement hand release.

APPENDIX

U. S. DEPARTMENT OF COMMERCE
CIVIL AERONAUTICS ADMINISTRATION

Form approved.
Budget Bureau No. 41-R062.4

MAJOR REPAIR AND ALTERATION FORM (AIRFRAME, POWERPLANT, PROPELLER OR APPLIANCE)

1. AIRCRAFT	MAKE DeHavilland	MODEL DHC-2	SERIAL NO. 1347	NATIONALITY AND REGISTRATION MARK N192Z
2. OWNER	NAME (First, middle, last) U.S. Dept. of Agriculture U.S. Forest Service		ADDRESS (Street and number, city, zone and State) 234 Federal Bldg. Duluth 2, Minn.	
3. COMPLETE ONLY FOR UNIT REPAIRED AND/OR ALTERED. DESCRIBE WORK ACCOMPLISHED ON REVERSE IN ACCORDANCE WITH CIVIL AERONAUTICS MANUAL 18.				
UNIT	MAKE	MODEL	SERIAL NO.	NATURE OF WORK (Check) MAJOR REPAIR MAJOR ALTERATION
a. AIRFRAME	♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦ (As described in item 1 above) ♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦♦			X
b. POWERPLANT				
c. PROPELLER				
d. APPLIANCE	TYPE AND MANUFACTURER	<div style="display: flex; justify-content: space-between;"> 5/3/61 L.O. Behrman 3-1K </div>		
4. AIRCRAFT WEIGHT AND BALANCE DATA This item must be completed by repair or alteration agency. However, in the case of a spare component, it will not be completed until such component is installed in an aircraft. At this time, it will be completed by the installing agency, if applicable.				
CATEGORY	EMPTY WEIGHT (Pounds)*	EMPTY CENTER OF GRAVITY (Inches from datum)*		USEFUL LOAD (Pounds)*
Restricted Sea	3529.5	42.41		1560.5
5. CONFORMITY STATEMENT (Complete and check)				
a. AGENCY'S NAME AND ADDRESS		b. KIND OF AGENCY		c. CERTIFICATE NO.
Eric G. Berg Box 808 Ely Minn.		<input checked="" type="checkbox"/> U. S. Certificated Mechanic. <input type="checkbox"/> Foreign Certificated Mechanic. <input type="checkbox"/> Certificated Repair Station. <input type="checkbox"/> Manufacturer. <input type="checkbox"/> (Check if repair or alteration was made under delegation option procedures.)		A&E 7904
6. I certify that the repair and/or alteration made to the unit(s) identified under item 3 above and described on the reverse or attachments hereto have been made in accordance with the requirements of Part 18 of the U. S. Civil Air Regulations and that the information furnished herein is true and correct to the best of my knowledge.				
April 11, 1961 (Date repair and/or alteration completed)		 (Signature of authorized individual)		
6. APPROVAL FOR RETURN TO SERVICE (Check and complete appropriate items) Pursuant to the authority specified below the unit identified in item 3 was inspected in the manner prescribed by the Administrator and is				
<div style="display: flex; align-items: center;"> <div style="margin-right: 10px;"> <input checked="" type="checkbox"/> APPROVED <input type="checkbox"/> REJECTED </div> <div style="margin-right: 10px;">} BY {</div> <div style="display: flex; flex-wrap: wrap;"> <div style="margin-right: 10px;"><input type="checkbox"/> CAA Designee</div> <div style="margin-right: 10px;"><input type="checkbox"/> Manufacturer</div> <div style="margin-right: 10px;"><input type="checkbox"/> Canadian Department of Transport Inspector of Aircraft</div> <div style="margin-right: 10px;"><input type="checkbox"/> CAA Aviation Safety Agent</div> <div style="margin-right: 10px;"><input type="checkbox"/> Repair Station</div> <div style="margin-right: 10px;"><input checked="" type="checkbox"/> Other (Specify) <i>Inspection Authorization</i></div> </div> </div>				
May 3, 1961 (Date of approval or rejection)		 (Signature of authorized individual, title or identification number)		
7. TO BE COMPLETED ONLY BY CAA PERSONNEL				
a. <input type="checkbox"/> Forwarded for engineering comment <input type="checkbox"/> See attached memorandum b. <input type="checkbox"/> Accepted _____ (Date) <input type="checkbox"/> Reinspected _____ (Date) <input type="checkbox"/> Spot Checked _____ (Date)				
_____ (CAA designation number)		_____ (Signature Aviation Safety Agent)		

INSTRUCTIONS

This form must be completed in duplicate each time a major repair and/or alteration is made of an aircraft, airframe, power-plant, propeller or appliance. After the repair and/or alteration has been inspected and item 6 completed, the original copy of this form will be made available to the aircraft owner for retention as part of the aircraft records. The duplicate copy is retained by the CAA for administrative purposes.

See CAM 18 for detailed instructions concerning the information to be furnished with this form and instructions concerning its preparation.

A. DESCRIPTION OF WORK ACCOMPLISHED.*

Installed water bombing tank on underside of fuselage. 125 gal. capacity. Overflow opening at top of tank eliminates possibility of overloading.

Tank made up from discarded Jet wing fuel tank.

Tank is suspended from landing gear fittings at fuselage, stations -16.00 and / 8.00 by strut bays made up of 4130 streamlined steel tubing 1" X 1 3/4" X .040, diagonal bracing between struts of same material.

6 dump gates at bottom of tank are actuated by a control rod in easy reach of pilot. Gates are closed by pulling bell crank "over center" against stop. To open push control handle down about one inch to unlock, weight of water will open doors wide. Tank empties instantly.

pickup tube

Water is securely attached to inside of right float in such a manner that at takeoff speed it is up out of water. It is necessary to reduce speed to pick up water. Tank can be filled in 15 seconds.

Tank installed so that C. G. of tank and aircraft coincide, both full or empty.

Rear 40" of tank closed off by water tight bulkhead, serves streamline purpose only.

Strength of struts 6000 lbs. each.

No changes of any kind were made to the aircraft structure.

Control placarded- WATER TANK, DOWN OPEN, UP CLOSED.

Removed factory installed tanks, pickup tube and controls.

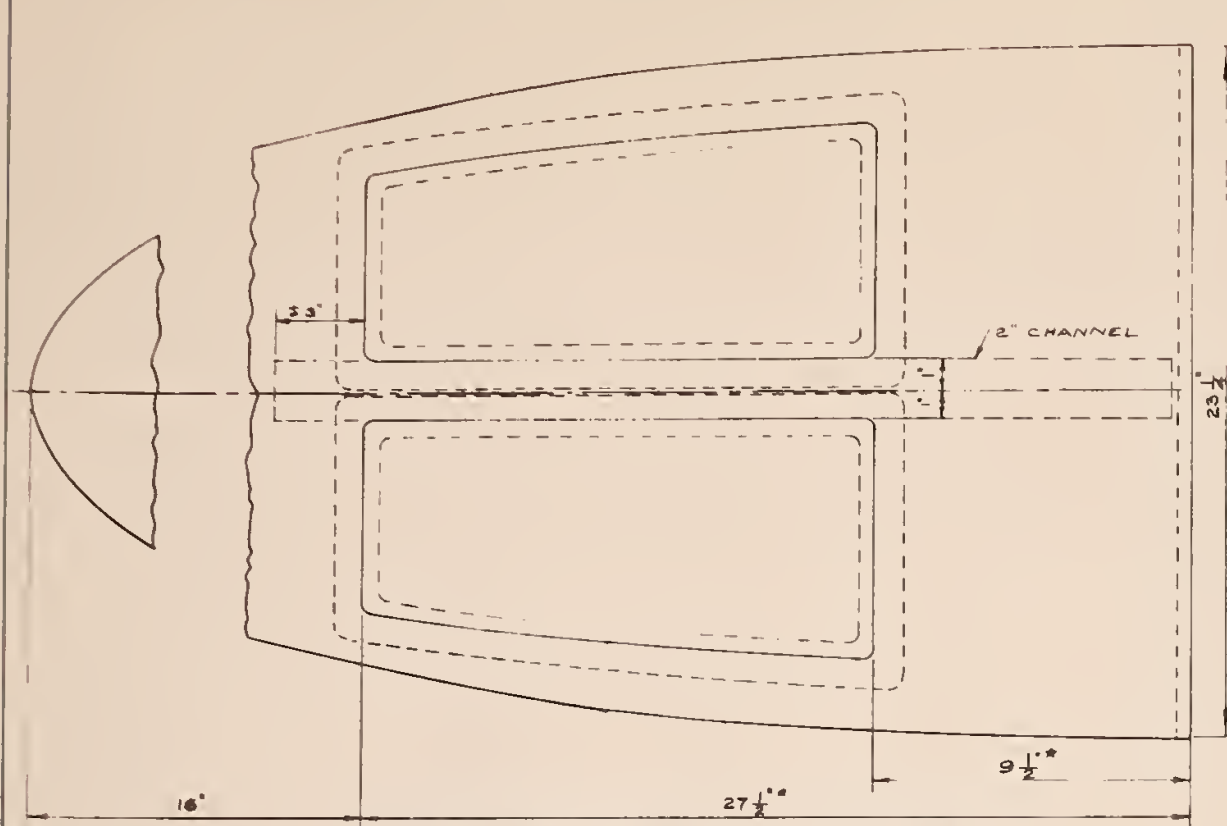
Airplane empty weight	3568		6332.5
Install tank & tube	110	+1.77	164.7
Removed tanks	123	-15.3	1882
" pickup tube	20	-9.8	196
" controls	5.5	+7.0	39
	3529.5		8536.2

Modified aircraft flight checked on May 3, 1961 by Carl M. Nelson in accordance with CAM.8.10-3 (e) and found to be safely controllable and to operate satisfactorily with the following special purpose load: 1900 lbs.

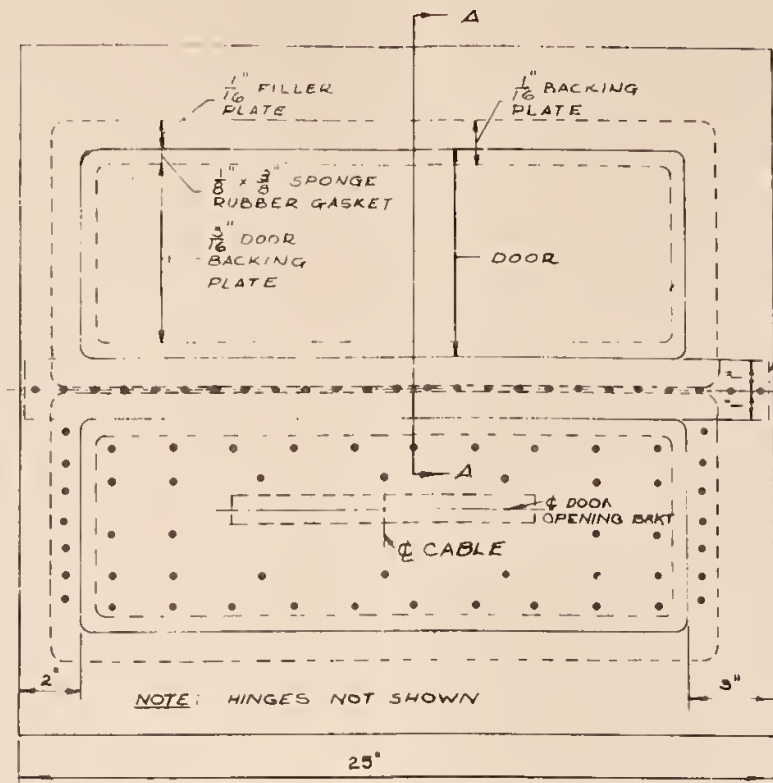
*If additional space is needed attach additional sheets bearing aircraft nationality and registration mark and date work completed.

Check block if additional sheets are attached. ☐

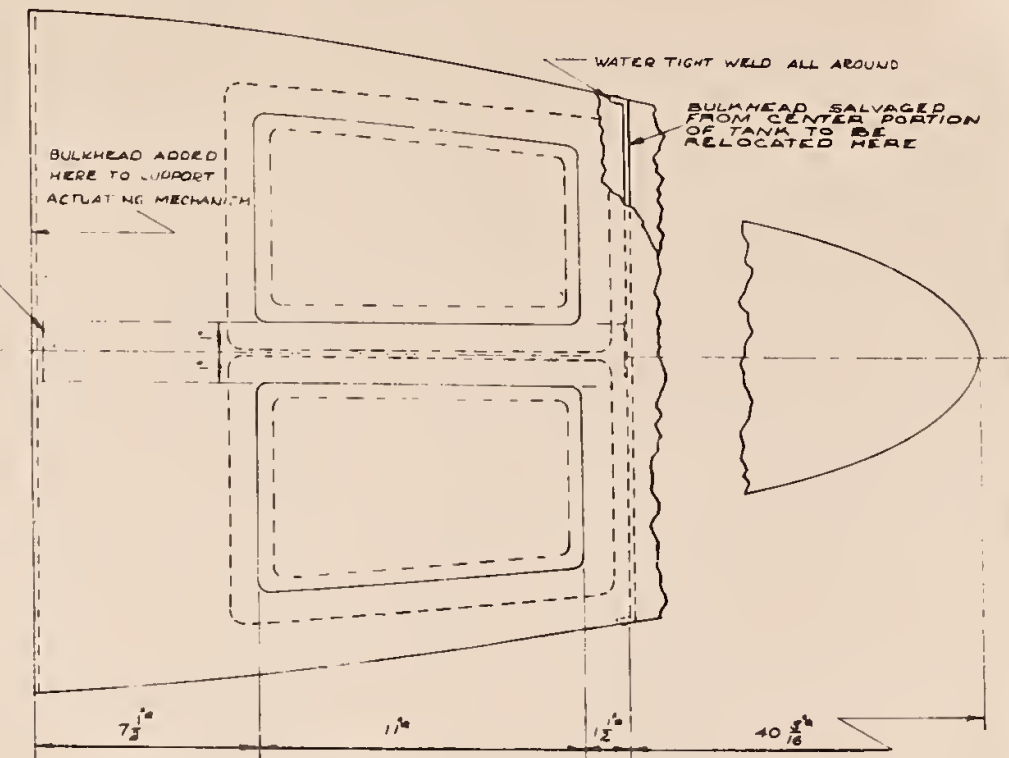




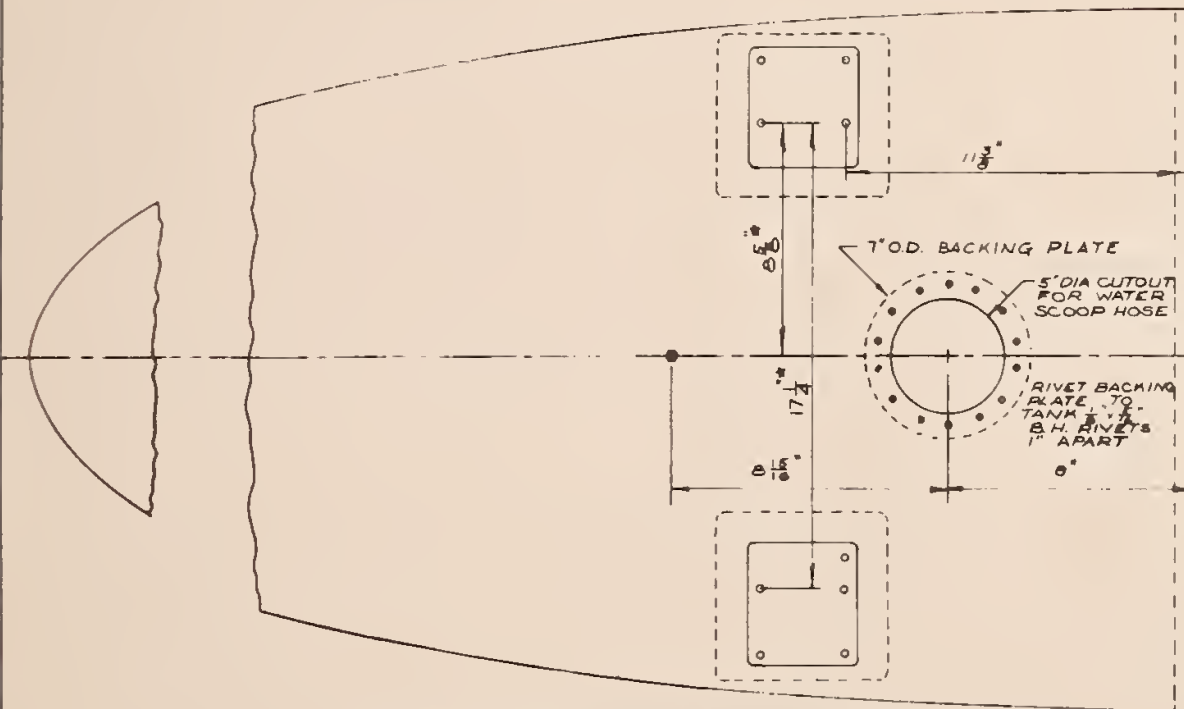
FORWARD SECTION OF TANK AS VIEWED FROM BOTTOM



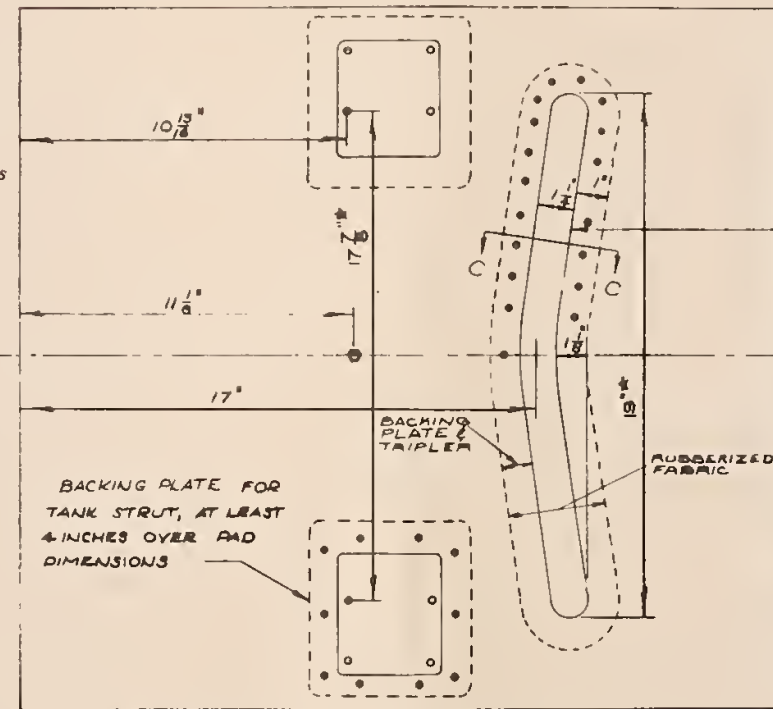
MID SECTION OF TANK, AS VIEWED FROM BOTTOM



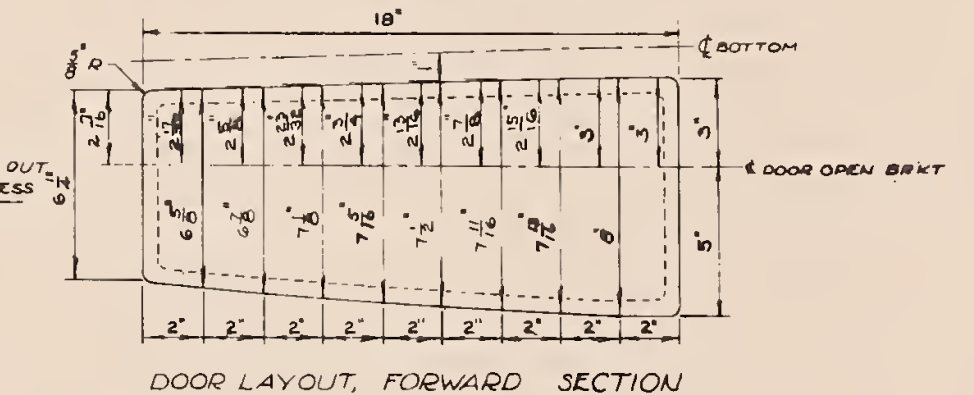
AFT SECTION OF TANK AS VIEWED FROM BOTTOM



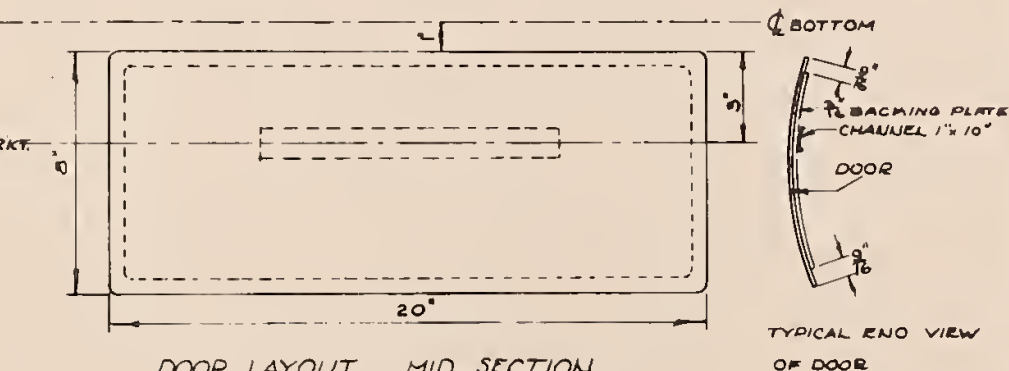
FORWARD SECTION OF TANK AS VIEWED FROM TOP



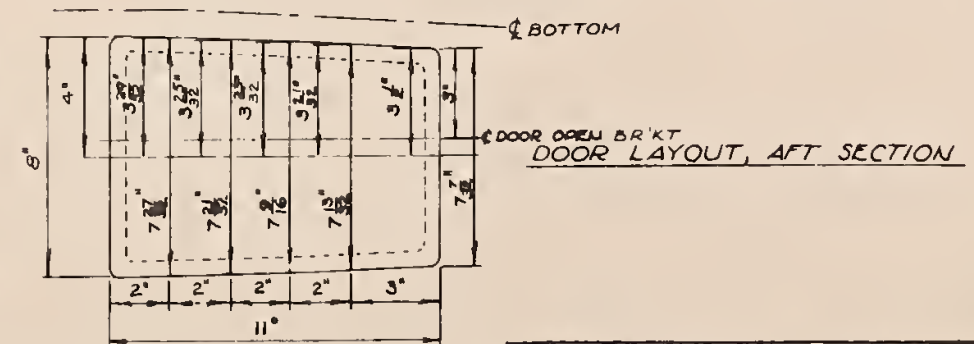
MID SECTION OF TANK AS VIEWED FROM TOP



DOOR LAYOUT, FORWARD SECTION



DOOR LAYOUT, MID SECTION



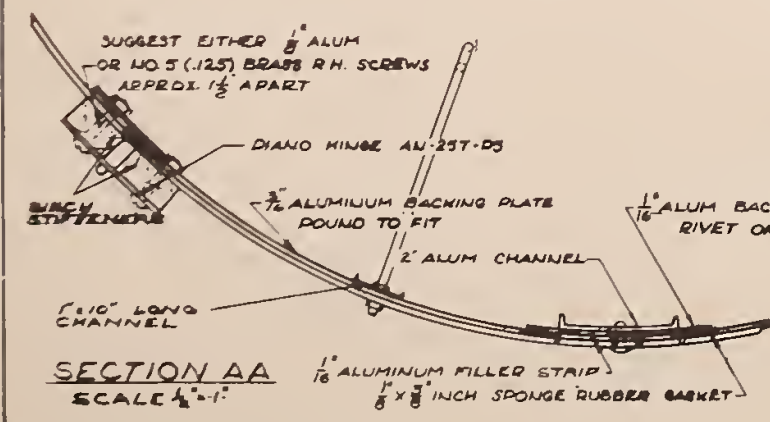
U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

REGION NINE E. B. ARTHUR, REGIONAL ENGINEER

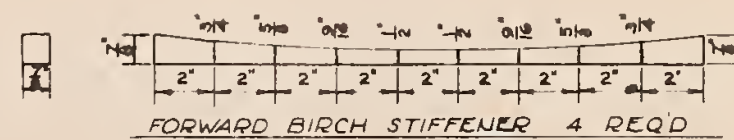
TEB #38 EXTERNAL WATER TANK
FOR DHC-2 BEAVER AIRCRAFT

TANK DETAILS

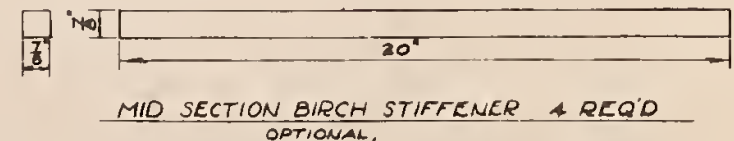
DESIGNED BY D. M. HARRIS, P.E. CHECKED BY L. J. HARRIS
SCALE 1/4" = 1" OR NOTED DATE 11/1/63
APPROVED BY J. M. HARRIS SHEET 2 OF 2



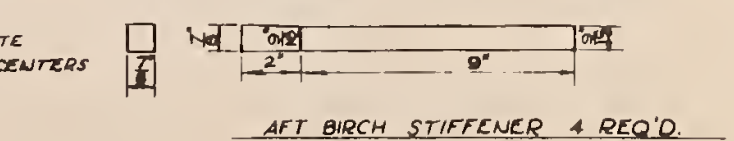
SECTION AA
SCALE 1/4" = 1"



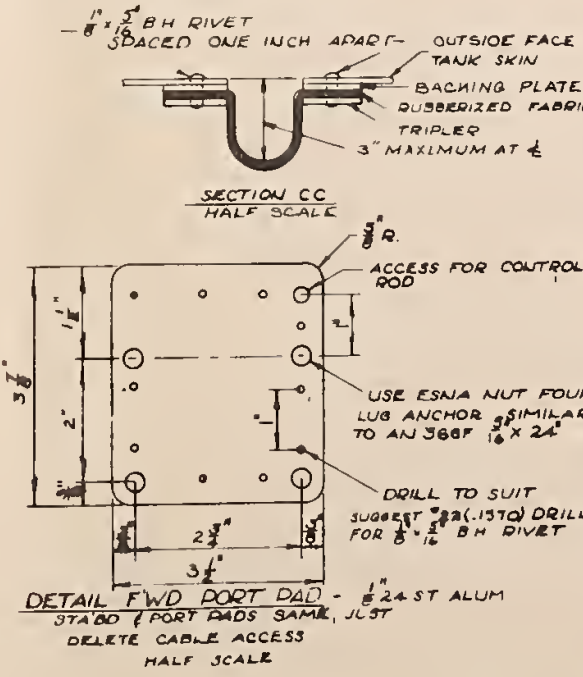
FORWARD BIRCH STIFFENER 4 REQ'D



MID SECTION BIRCH STIFFENER 4 REQ'D
OPTIONAL



AFT BIRCH STIFFENER 4 REQ'D

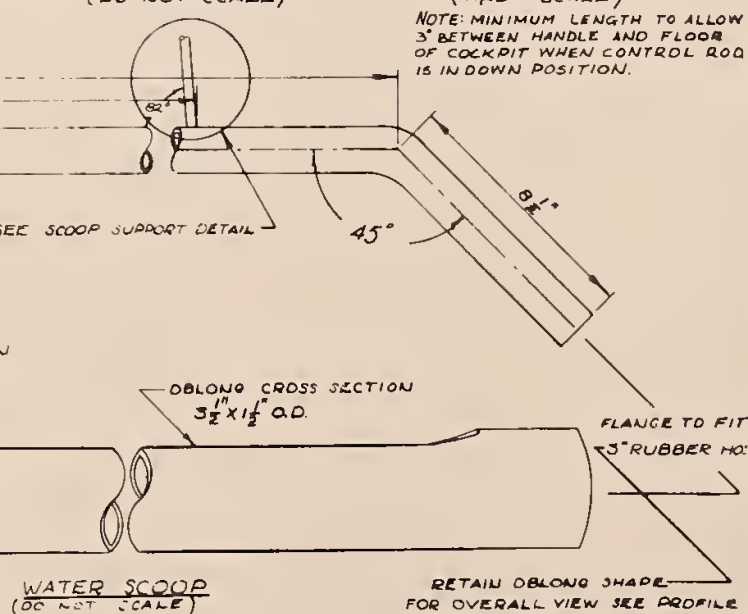
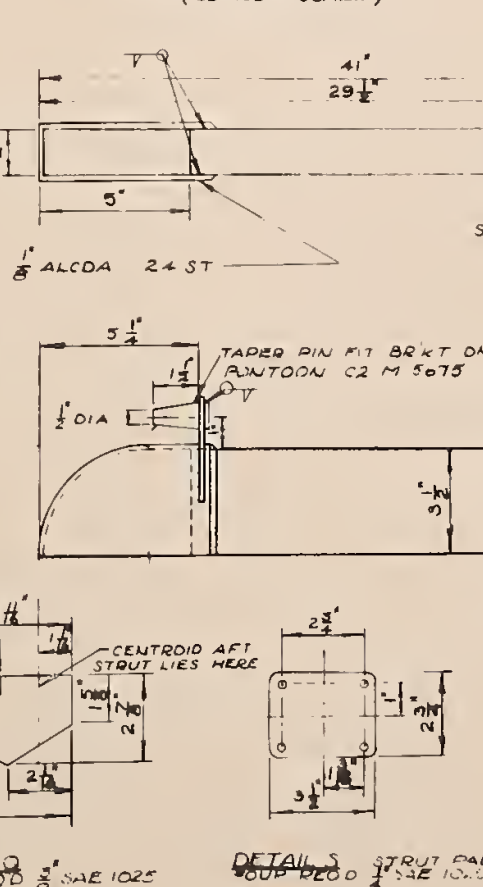
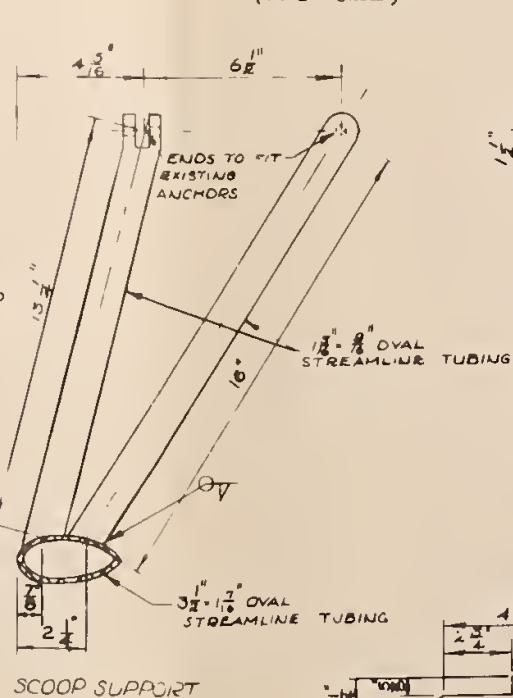
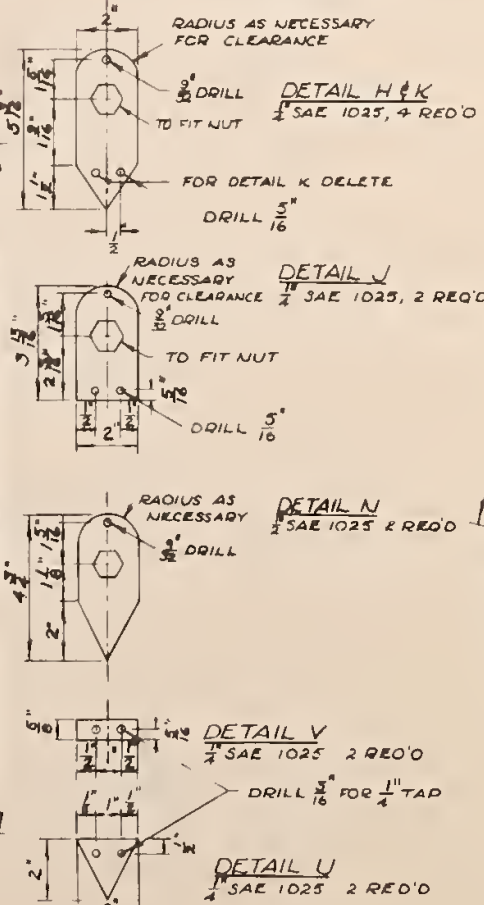
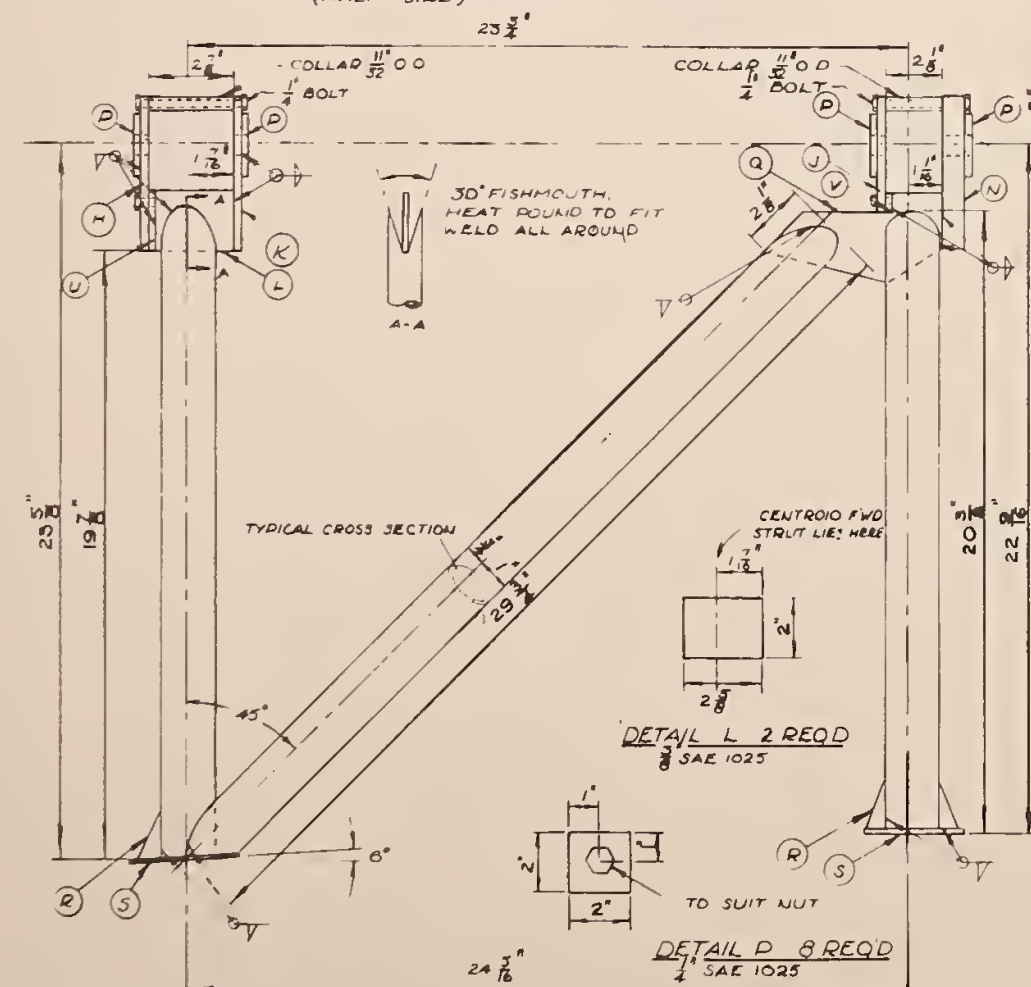
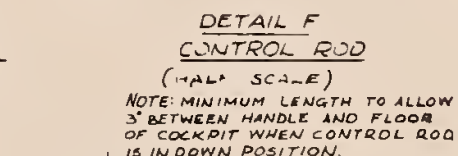
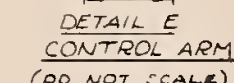
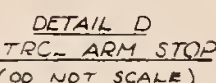
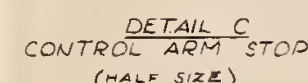
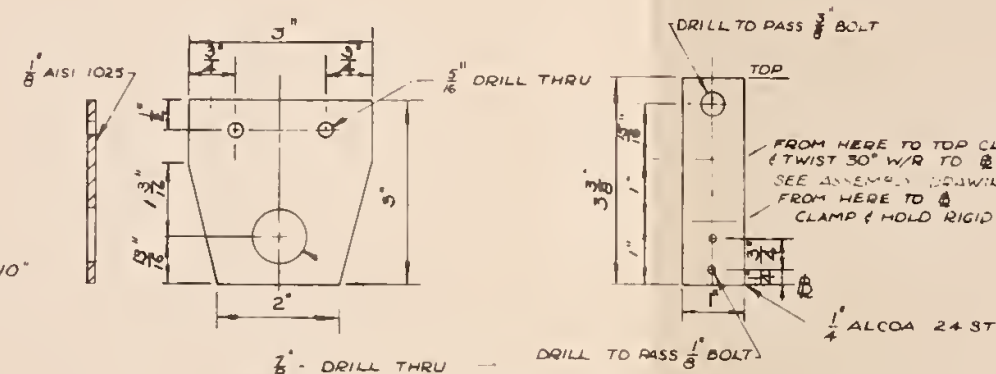
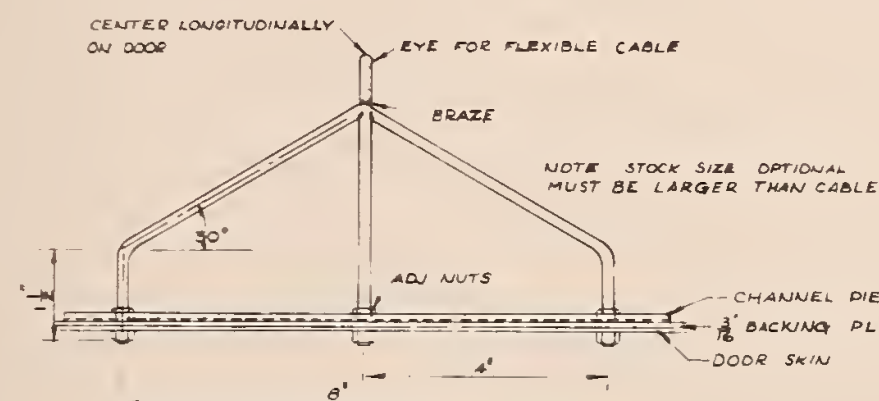
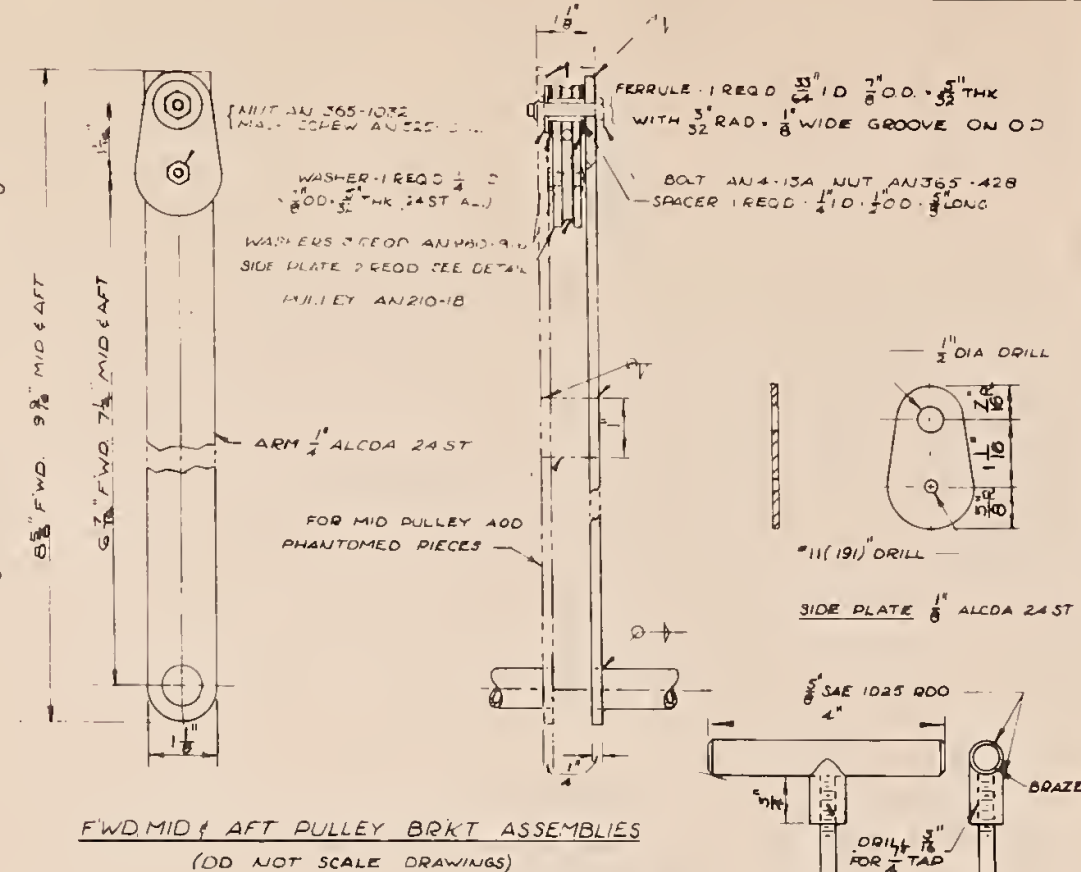
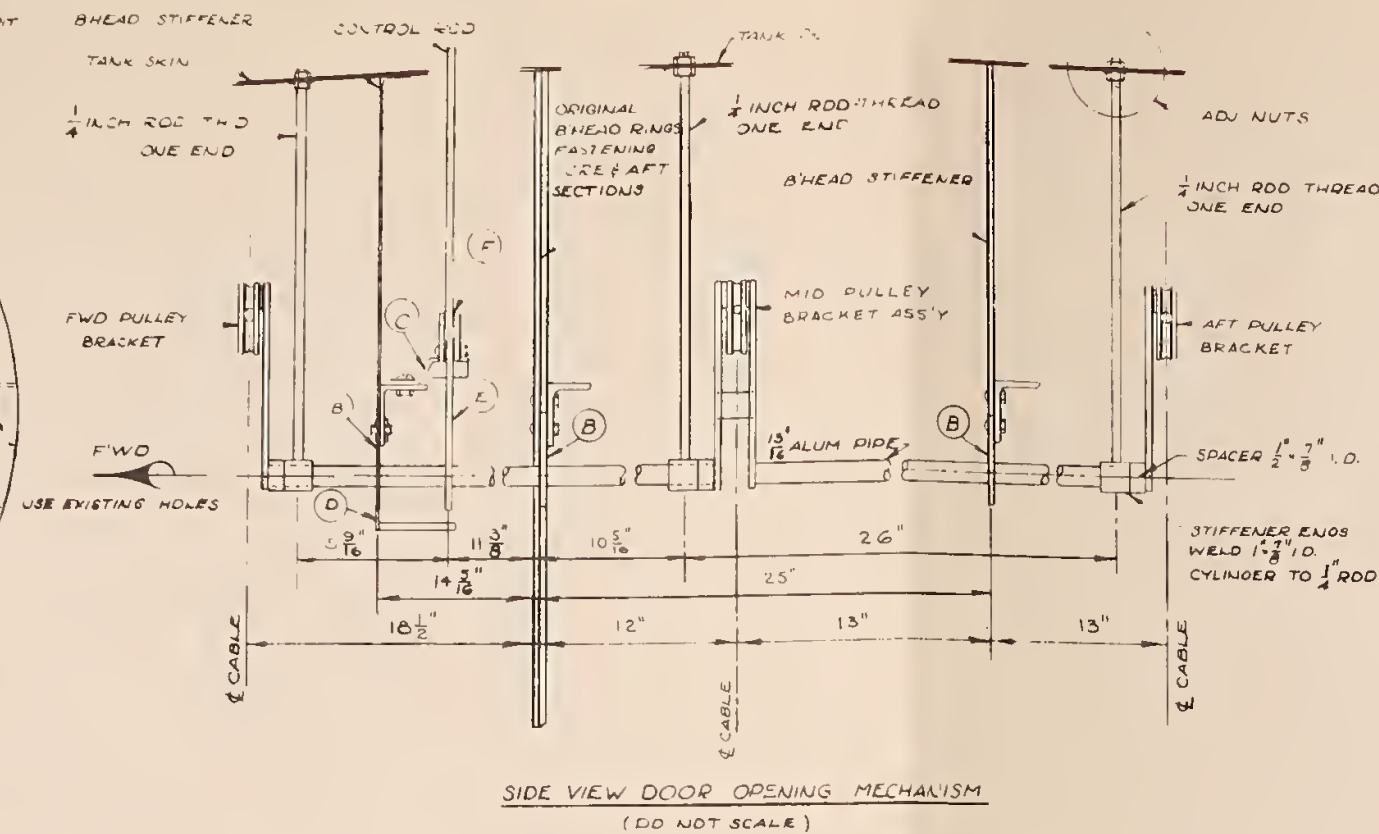
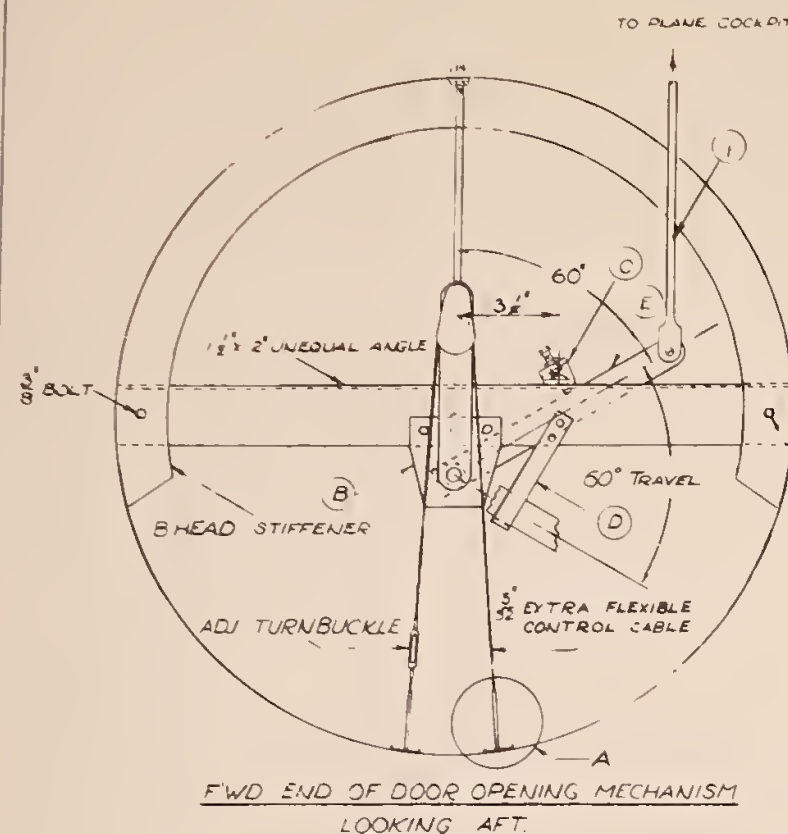


DETAIL FWD PORT PAD - 1/16" 24 ST ALUM
STAB (PORT PADS SAME, JUST
DELETE CABLE ACCESS
HALF SCALE

NOTE: LAYOUT DOOR PATTERN ON TANK
CUTOUT & SAVE FOR DOOR, THEN USING
DOOR FOR PATTERN, CUT PLATE OF 1/16"
ALUM, REDUCING SIZE BY 1/8" ALL AROUND
EDGE - RIVET TOGETHER
FOR 1/16" FILLER STRIP USE DOOR CUTOUT FOR
PATTERN & ADD ONE INCH ALL AROUND,
FOR 1/16" PLATE, USE FILLER STRIP FOR
PATTERN & ADD 1/2 INCH INSIDE

* DENOTES ARC LENGTH

7640



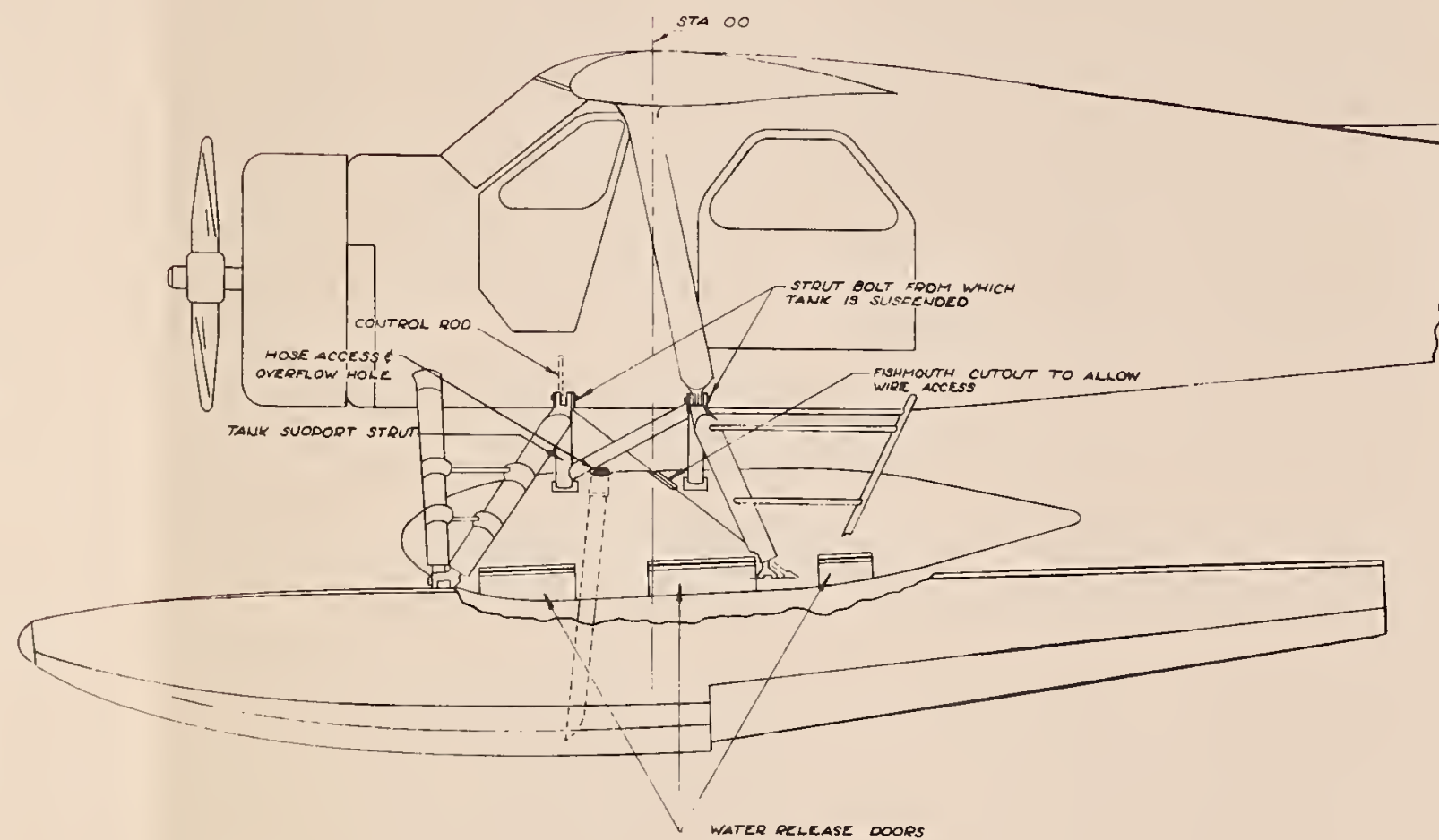
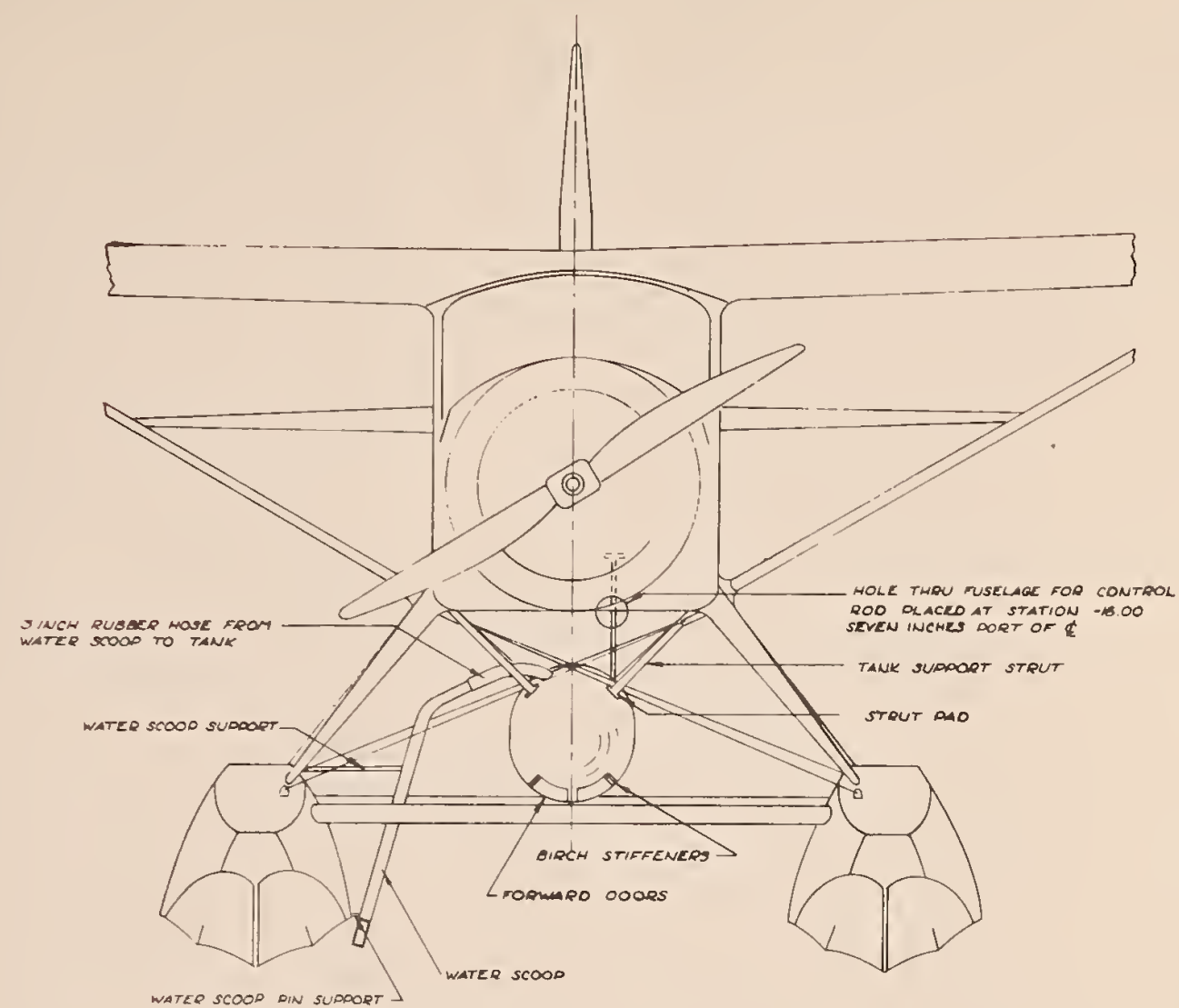
U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

REGION NINE M. B. ARTHUR, REGIONAL ENGINEER

TEB "838 EXTERNAL WATER TANK
FOR DHC-2 BEAVER AIRCRAFT

OPENING MECHANISM, STRUT,
AND SCOOP DETAILS

DESIGNED	<u>LD-MIER</u>	DRAWN	<u>RZ</u>	TRACED	
SCALE	<u>1/2" = 1' OR NOTED</u>			CHECKED	<u>LBN</u>
APPROVED	<u>[Signature]</u>			DATE	<u>1/11/62</u>
				SHEET	<u>3</u> OF <u>3</u>



FRONT & PROFILE VIEW OF WATER TANK ASSEMBLY

U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

REGION NINE W. B. ARTHUR, REGIONAL ENGINEER

TEB #838 EXTERNAL WATER TANK
FOR DHC-2 BEAVER AIRCRAFT

ELEVATIONS OF ASSEMBLY

DESIGNED L.D. HILL & B. BRADY RZ	TRACED
SCALE NONE	CHECKED J. L. G. N.
APPROVED <i>[Signature]</i>	DATE 1/11/62
	SHEET 1 OF 3

